A REPORT ON SUCCESSION STUDIES OF SELECTED PLANT COMMUNITIES ON THE UNIVERSITY OF FLORIDA CONSERVATION RESERVE, WELAKA, FLORIDA

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Introduction

This study of the plant communities of the University of Florida Conservation Reserve was begun in December, 1939. I am much indebted to J. Speed Rogers for the interest and encouragement he gave toward the initiation and completion of my dissertation on this subject which was published in July, 1942. My interest in plant communities and their succession in Florida has been continuous since then, but field work on the Reserve was limited largely to irregular observations until September 1951, when permanent quadrats were set up on selected sites. I regret that permanent quadrats were not constructed in 1939 when my studies began. I can only say that I then had no idea that I would remain in this general area nor did I know that I would have any opportunity to continue this study on the Reserve.

Permanent Quadrats

Permanent quadrats are set up in the following manner and involve the following considerations:

1. *Size*—Inasmuch as trees and shrubs were the main vegetation studied all quadrats are at least 100 x 100 feet. One, 160 x 160 feet, was made because it contained many large and widely spreading live-oaks.
2. *Location*—The location of quadrats was chosen by estimating examples of typical communities as exemplified at their time of classification given by Laessle, 1942. Wherever such examples were satisfactorily represented within one of the four inviolate areas of the Reserve, they were so located, but two, one in a mature live-oak hammock, and one a black-pine and fetterbush flatwoods, are located in non-inviolate areas. The quadrats are clearly marked and designated as inviolate.

3. *Marking*—Concrete posts measuring 4 x 4 inches and 3 feet long were set at the corners of each quadrat, leaving the upper foot above ground level. Where the quadrats were located at considerable distance from obvious reference points, bearings and measured distances were taken from such obvious reference points as road or fence intersections. These data were recorded and plotted on a map of the Reserve.
4. *Mapping and vegetation*—In order to get a fairly accurate map of the woody species within the quadrats the area was laid off in twenty foot squares by running twine at twenty foot intervals from two adjacent sides to their opposite sides. The approximate position of each plant was then mapped using different symbols for each species. When the diameter breast high was an inch or more this D. B. H. was recorded to the nearest inch, either within the symbol or close enough to it, to indicate definitely to which symbol the figure refers (Fig. 4). This should enable one to record, not only of the rate of growth of each tree, but also of those which succumb and new invaders as well. I have not decided how often it will be advisable to re-map these quadrats, but time intervals for profitable re-evaluations will no doubt vary in different sites having variable rates of succession.
5. *Herbaceous vegetation*—Only lists of the more important herbaceous species and vines were made. This data is omitted in this reoprt.
6. *Soil profiles*—One soil profile was made from a recorded corner of each quadrat. A soil auger was used to get this record to a depth of four feet. No subsequent comparisons have yet been made as six years is probably much too short a time to yield any recognizable changes.
7. *Photographs*—Photographs of each quadrat were made from recorded positions, (Figs. 1 and 2). Dated negatives are in my files.

Findings and Interpretations

Quadrat 1

This quadrat, measuring 160 feet per side, is located in what I classified as xeric or live-oak hammock (Laessle, 1942 : 36) and has

Figure 1. Facing S.E. toward the W. corner of Quadrat No. 1. This photograph was taken in May, 1942. Fire protection had been in effect since 1935. Notice the small amount of Spanish-moss. The ground cover is mostly myrtle-oak.

Figure 2. This photograph was taken from the approximate position as the above, in October 1956. In addition to the great increase of Spanish-moss, notice the increase in the height of the myrtle-oaks, laurel-oaks are now evident just to the right and left of the center.

not been burned since 1936. Prior to this time fire had been of almost yearly occurrence. Tabulation of the principle tree species in D. B. H. is given in Table 1 below.

TABLE 1

D.B.H. inches	Live-oak	Laurel-oak	Myrtle-oak	American-holly	Slash-pine	Swamp red-bay	Longleaf-pine
< 1	4	44	very abundant	4	2	2	1
1	2	37	12	1	1	0	0
2	0	20	3	5	0	0	0
3	1	11	0	1	0	0	0
6	6	0	0	0	0	0	0
7	4	0	0	0	0	0	0
8	4	0	0	0	0	0	0
9	7	0	0	0	0	0	0
10	5	0	0	0	1	0	0
11	6	0	0	0	0	0	0
12	3	0	0	0	0	0	0
13	5	0	0	0	0	0	0
14	4	0	0	0	0	0	0
15	3	0	0	0	1	0	0
17	3	0	0	0	0	0	0
18	1	0	0	0	0	0	0
20	1	0	0	0	0	0	0
25	1	0	0	0	0	0	0
27	1	0	0	0	0	0	0
31	1	0	0	0	0	0	0

The number of individuals falling into each D.B.H. is given under the species name at the top of each column. Young cabbage-palms, (*Sabal palmetto*) were abundant but are omitted here as none had trunks of breast height.

Some speculation regarding the history of this site before fire protection was initiated in 1935 seems appropriate. There are some very large longleaf-pine stumps present and some of the larger live-oaks must be at least one hundred years old. These facts, plus the fact that the hammock is roughly circular in shape rather than the typically rectangular outline characteristic of cultivated fields, makes it seem unlikely that the area was ever cleanly cultivated. The low widely spreading branches of the live-oaks, (Fig. 1), indicate that these trees underwent early growth either in the open or under a rather open canopy. Either of these conditions may have been created well over a hundred years ago when the region was first lumbered. This part of Florida was fairly well settled in Bartram's time (Bartram, 1791). It seems likely that the site had been subject to fires from both lightning and man for a very long time, and that the dominant vegetation was once longleaf-pine with an understory of small live-oaks (*Quercus virginiana*) and myrtle-oaks (*Q. myrtifolia*).[1] Even before the cutting of the pines it is probable that occasional very severe fires occurred, killing most live and myrtle-oaks to the ground, but leaving the larger longleaf-pines unharmed. Sprout growth from the oaks would grow until another fire. Once-in-a-while, due to chance, a live-oak would attain such size and thickness of bark to be fire resistant enough to reach maturity. Many of the present live-oaks bear fire scars.

Analysis of Table 1 shows that the more fire susceptible species, especially laurel-oaks (*Q. laurifolia*), have invaded the site in great numbers. Increment borings of the largest laurel-oaks showed them to be about twenty years old, or to have existed just about the length of time since the last fire. There is no evidence that any of this species are from sprout growth. An attempt to date the last severe fire by counting the rings that have accumulated in the overgrowth of the partially healed-over fire faces of the live-oaks failed because of the difficulty of recognizing growth rings in this species.

One of the most puzzling aspects of the quadrat is why the live-oaks are not reproducing. In good seed years, the ground is almost covered with viable live-oak acorns. Lack of sufficient light under the thick canopy might be considered the critical factor, however, there are a number of openings in the canopy which receive at least one-half full sunlight, still there is no live-oak reproduction here. Perhaps the answer lies in the severity of root competition?

Another question which arises is the paucity of holly, (*Ilex opaca*) and complete lack of magnolia, (*Magnolia grandiflora*) and other components of the mesic hammock (Laessle, 1942 : 37) in comparison to the large number of recently invading laurel-oaks. This I believe to be due to chance, as mature laurel-oaks are abundant in the nearby mesic hammocks bordering the St. Johns River, while mature trees of holly and magnolia are both farther away and fewer

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[1] Nomenclature follows Small, 1933.

in number. The presence of swamp red-bay (*Tamala pubescens*) normally a swamp of bayhead species, in such a well drained site is surprising. Observations at the Reserve show that other characteristically hydric species as swamp-maple, (*Rufacer rubrum*) and whitebay (*Magnolia virginiana*) are invading drier sites than those in which they are usually found. I believe that their usual restriction to hydric situations is primarily due to their susceptibility to fire rather than their need for abundant water. It seems that red-bay (*Tamala borbonia*), a characteristically mesic hammock species, would be more likely to invade this site. I believe it would, other factors being equal, but the swamp red-bays are abundant in a nearby bayhead only five hundred feet away, while mature red-bays are at least a mile distant.

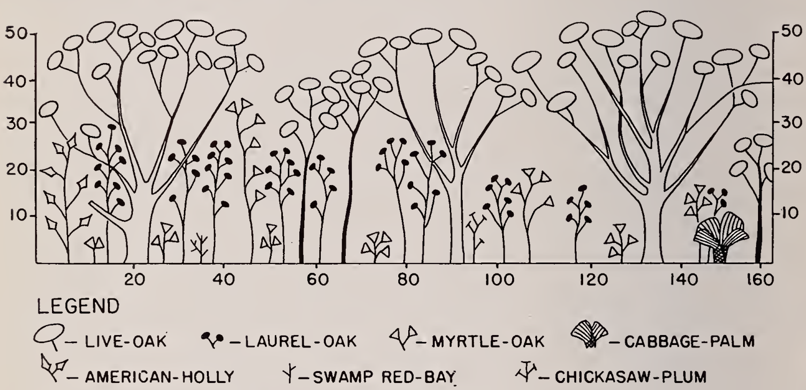

Figure 3. This profile includes a strip about twenty-five feet wide along the N. W. side of Quadrat No. 1. Small sprouts of myrtle-oak, small cabbage-palms and vines are omitted. Numerals are in feet. Sketched October, 1956.

Quadrat 2

This quadrat is in what was classified as the *Pinus australis-Quercus cinerea* Association (Laessle, 1942 : 35). When my first study of the Reserve was made, this site contained numerous live-oaks, the larger only five to six feet tall. Next to Quadrat 1 above, this shows more rapid successional change than any other of my permanent quadrats. Here the soil is similar to that of Quadrat 1, Blanton fine sand. The topography is also similar, being surrounded by slightly lower longleaf-pine flatwoods, except on the east, where it merges with scrubby flatwoods (Laessle, 1942 : 29-30). The following Table was derived from the mapped quadrat Fig. 4.

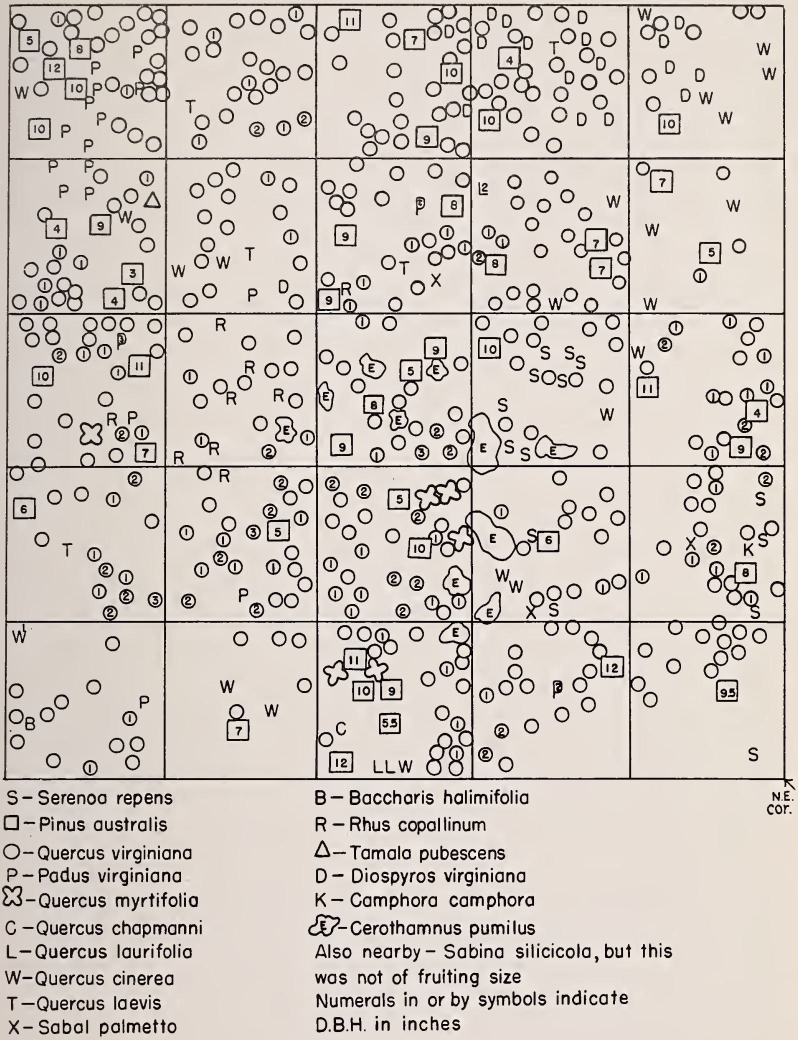

Figure 4. Map of Quadrat No. 2 showing the approximate position and D.B.H. of trees and shrubs. Clump outlines rather than individual stems are used for the root-sprouting wax-myrtle. The smaller squares measure twenty feet per side.

In addition the following species, all with a D.B.H. of less than one inch were: *Cerothamnus pumila*-11 clumps, *Diosypros virginia*-14 small stems all within a radius of twenty feet and probably all sprouts from a single root system, *Rhus copallinum* - 7 stems, probably root clones, *Tamala pubescens* - 1, *Camphora camphora* - 1, *Serenoa repens* - 12 small clumps, *Quercus chapmanii* - 1, *Sabal palmetto* - 1.

TABLE 2

D.B.H. (inches)	Longleaf pine	Live-oak	Black-cherry	Laurel-oak	Bluejack oak	Turkey-oak
< 1	0	321	10	2	20	4
1	0	60	0	0	1	0
2	0	30	2	1	0	0
3	1	3	1	1	0	0
4	4	0	0	0	0	0
5	6	0	0	0	0	0
6	2	0	0	0	0	0
7	6	0	0	0	0	0
8	5	0	0	0	0	0
9	9	0	0	0	0	0
10	9	0	0	0	0	0
11	4	0	0	0	0	0
12	3	0	0	0	0	0

Table 2 is deceptive in the apparently great number of live-oaks—most stems are root clones.[2] Further analysis shows that longleaf pine have not reproduced since the last fire about 20 years ago, or shortly thereafter. One can easily visualize that this quadrat would, in the continued absence of fire, develop into something

[2] As most observers in this region have no doubt noticed, live-oak is a very heterogeneous species and, in my experience, even genetically identical specimens are markedly modified morphologically in different environments. A number of years ago I transplanted from the Reserve scrub a typical example of the strongly revolute margined, strong veined form, which Small named *Q. geminata*, to a mesic hammock near Gainesville, Florida. All leaves formed in the new habitat were nearly flat with scarcely revolute margins. An additional observation as to the plasticity of the some of its verieties occurred in the study of my permanent transect in the longleaf-pine flatwoods (Laessle, 1942:43). Dwarf live-oak [*Q. minima* (Sarg.) Small] was once common in this habitat. When my transect was mapped in 1951 examples of this species were absent, but there were scattered small live-oaks up to six or eight feet tall. In April, 1956, a severe fire killed all this vegetation to the ground. On a visit to this spot on October, 1956, there were new sprouts from the burned root-stocks. All showed the characteristic toothed leaves of *Q. minima*, while the charred six to eight foot stems of what could only fit *Q. virginiana* before the burn, were still sticking up from the same rootstocks. So, in my opinion, *Q. minima* is merely a fire and flatwoods ectotype of a freely root-sprouting variety of *Q. virginiana*.

similar to Quadrat 1 except that there would be a marked telescoping of stages—exemplified by some laurel-oak being as large as the largest live-oak.

The naturalized species camphor, (*Camphora camphora*), while scattered, is apparently destined to become an important element in the development of the Reserve's hammocks—providing that fire is eliminated. The same may be said for most of the northern and central Florida.

It is my belief that the small blue-jack oaks and turkey-oaks in this quadrat will soon succumb to the severe competition for light, water, etc., which, while severe now, will become increasingly so in the future. Why invading laurel-oaks do not occur in as large number as found in Quadrat 1 is not apparent to me. The proximity of seed trees of this species is certainly as favorable here as it is there.

Many of these quadrats show very little successional change at this time. A quadrat in the sandhills Longleaf-pine—Turkey-oak Association, (Laessle, 1942 : 30) showed practically no evidence of invading species except five sand-pine (*P. clausa*). The larger two had a D. B. H. of five inches. Some small magnolia were noticed in nearby portions of the sandhills, outside the quadrat. In order to get some sort of estimate of their rate of invasion, an area much larger than my quadrat, but including it, was sampled by walking in parallel lines spaced one hundred feet apart and counting invading species fifty feet to each side of these lines. As ground cover was very sparse, and larger vegetation widely spaced, I feel certain that no invading species over a foot tall was missed. An area of roughly thirteen acres was covered in this manner, and the following number of invading species recorded: Sand-pine—35, magnolia—5, black-cherry—2, Chapman's-oak—2, wild-olive, (*Amarolea americana*)—1, cabbage-palm—1 (small), camphor—1. Live-oak is not considered an invader, as small trees and sprout growth are characteristic of this association even when burning is frequent. All of the invaders, except the cabbage-palm, are intolerant of fire and would not occur in a longleaf-pine—turkey-oak community exposed to the almost annual burning which has obtained in Florida.

The southern portion of this thirteen-acre area is within about a quarter of a mile north-east of a mesic hammock containing many mature magnolias. It was noticed that four of the five invaders of this species were in the southern half of the area. The nearest mature sand-pines were about the same distance south of the area. No mature camphor trees are known to occur within at least a mile, but as the pits of this species and of the black-cherry are transported by birds, their migration to this area is understandable. The peculiar thing, in the light of the very rapid invasion of the laurel-oaks in Quadrat 1, is that no laurel-oaks have invaded here, though mature trees of this species are abundant within a third of a mile to the south. I have no doubt that many laurel-oak acorns have been transported to the area, probably more of them than magnolia seed. Laurel-oak is frequently one of the first invaders in the long-leaf-pine-turkey-oak (generally Lakeland soils) around Gainesville. I am aware of no environmental factor which would prevent the establishment of this species on the Reserve's Lakeland soils unless some critical element is lacking. No significant difference in either the macro nor micro-elements found in Blanton fine sand, the series of soil in Quadrat 1, and Lakeland of the same texture, was apparent in (Gammon et al, 1953). In fact there was often more variation in these elements in examples of the same series than in selected examples from the two series. Analyses of soil samples from the Reserve might give more conclusive information.

The demonstrated ability of magnolia to become established on the excessively drained poor sands of the Reserve's sandhills does not seem so surprising when it is realized that is common in the dunes of western Florida (Kurz, 1942). It is apparently tolerant to both strong light and deep shade, and is able to survive with meager amounts of those nutritional elements generally required in plant nutrition, but its rate of growth is much retarded in poor soils.

Reports on successional studies from other quadrats of the Reserve must await more conclusive changes in vegetation. Changes in soil profiles will no doubt lag behind vegetational changes for variable lengths of time but I hope that at least some of these will be evident during whatever time is alloted me to continue this study.

Observasions and Generalizations

A number of scattered observations concerning plant succession on the Reserve seem worthy of presentation. During the twenty years of fire protection there has been a surprisingly rapid spread of red-maple from its former confinement to river swamps to the flatwoods, particularly to those portions adjacent to the swamps.

The absence of fire has also permitted a considerable extension of the bayhead flora, especially loblolly-bay (*Gordonia lasianthus*), to the moister portions of the flatwoods. This substantiates my hypothesis (Laessle, 1942 : 103), that in the absence of fire, bayhead species would invade the lower, more moist portions of the flatwoods. There is also increasing substantiation of my opinion that the drier portions of the flatwoods are being invaded by hammock species, particularly live-oak, although a number of magnolia and swamp red-bay have been observed growing well in this habitat. The magnolias are doing much better here, as individuals, than in the sandhills. A number of trees six to seven feet tall were observed here, while the largest sandhill specimens are scarcely three feet tall.

A Look into the Future

Unless fire or some unnatural disturbances take place, the Reserve's quadrats should not only yield definite information regarding the stages of plant succession on most of the soil series of peninsular Florida, but should also yield a fairly accurate measure of the rate of these changes. I expect that, as invading species reach seed bearing size or age, the rate of succession should accelerate, not only because of the increased number of seed produced, but also because of soil changes which should also accelerate as more and more invaders modify the areas. As succession progresses the sharp ecotones between the predominantly fire climax communities obtaining when I first studied the Reserve should become broader and less clear cut. Indeed this tendency is already apparent in some areas. I do not expect that, even within a thousand years, the vegetation will become homogeneous throughout including the better drained areas of flatwoods, sandhills, hammocks and scrub. I believe that a mesophytic hardwood climax would develop in all these situations. I am a supporter of the polyclimax concept. It does not seem possible, for instance, that soils derived from deposits of nearly pure sand could ever support a flora even approximating that derived from limestone, or limy materials such as the shell mounds at Orange Point (Laessle, 1942 : 59-60). Observations of almost undisturbed calcareous climax hammocks to the west and southwest of Gainesville show them to have considerable numbers of such trees as box-elder (*Negundo negundo*), hammock-maple (*Saccharodendron floridanum*) and Shumard's-oak (*Q. shumardii*), in addition to the species characteristic of the sandy mesophytic hammocks of the Reserve. The calcareous hammocks also have a noticeably higher component of deciduous elements than do any of the sandy hammocks observed in the northern and central parts of peninsular Florida. Such observed floristic differences, while in part probably influenced by the higher pH of the calcareous soils, are no doubt also influenced by the generally richer and more clayey nature of these soils.

The effects of chance will be more pronounced in the early vegetational changes following both fire climaxes and secondary successions. This is particularly obvious when one considers the comparative scarcity and generally widely separated stands of most of the climax associations—both on the Reserve and in most of peninsular Florida.

Literature Cited

BARTRAM, WILLIAM
1791. Travels through North and South Carolina, Georgia, East and West Florida. Philadelphia.

GAMMON, NATHAN ET AL
1953. Physical, spectographic and chemical analyses of some virgin Florida soils. Univ. of Fla. Ag. Exp. Sta., Tech. Bull. 524.

KURZ, HERMAN
1942. Florida dunes and scrub, vegetation and geology. Fla. Geol. Surv., Geol. Bull. 23, Tallahassee, Fla.

LAESSLE, A. M.
1942. The plant communities of the Welaka area, with special reference to correlations between soils and vegetational succession. Univ. of Fla. Publication. 4(1).

SMALL, J. K.
1933. Manual of the southeastern flora. Science Press Printing Co., Lancaster, Pa.